Master thesis for the Master of Philosophy in Economics degree

Child mortality and community-level education

- An analysis of the impact of other women's education on child mortality in sub-Saharan Africa

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Preface

First of all, I would like to thank my supervisor Øystein Kravdal for precise feedback and excellent supervision in the writing of this thesis.
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Contents

1. Introduction

A woman's education as a determinant in different demographic processes has been the subject of many studies during the last 30 years and it has been proven to have an impact on fertility, health, and mortality.

In 1979, John Caldwell published an article that argued for a strong causal relationship between a mother's education and child survival. Up to this point, the focus of research had been on the importance of economic, medical and technological progress as key factors in reducing child mortality in developing countries (Caldwell, 1979).
Caldwell's article set the stage for a series of papers concerning the impact of a woman's education on the survival and well-being of her children. In poor countries, education is (of course) a goal in itself as a way to increase the generation of income and raise living standards. However, this new awareness of the importance of women's education as a way of reducing the mortality in developing countries has made investments in girls' education an even more important part of development programs.

Several mechanisms and factors combined explain this causal relationship, one of which is the fact that young girls enrolled in schools obtain basic knowledge on subjects such as hygiene and sanitation. Education also makes the women more likely to have their children vaccinated; it will make them able to communicate better with health care workers and gives them a higher inclination to use contraceptives. In addition, education is thought to increase a woman's autonomy within the household and in society in general. This individual-level effect of education is found to be reduced when taking into consideration socioeconomic status and community variables such as wealth and whether the woman lives in an urban or a rural area. The reason for this is that while education may be a determinant for wealth and place of residence, it may also be that the wealth and attitudes of a woman's parents and where she grew up have an impact on her education.

The possible community-level effects of education, however, have not received much attention in the literature on child mortality. The effect of women's average education level has been estimated for India (Kravdal, 2004), and was found to increase the total effect of education. This has yet to be attempted for sub-Saharan Africa. If estimates show similar results for the selected countries in this region, then educating young women is possibly even more important than what has been previously assumed.

This thesis will examine how child mortality is influenced by the mother's own education and the education of other women in the community. It is likely that in sub-Saharan Africa, like in India, the education of the other women in the community will prove to be an important factor even when it, for example, is controlled for whether the community is in an urban or rural area. Furthermore, I will examine whether community-level education may have an impact on AIDS-related mortality.

I have used data from the Demographic Health Survey arranged by Øystein Kravdal, and estimated logit regression models using SAS to see the effects of individual- and community-level education, socioeconomic factors and HIV on child mortality.

The extent of child mortality and its main causes are discussed in chapter 2, along with the problem of the HIV-pandemic in sub-Saharan Africa. In chapter 3, I explain the causality between education and child mortality and discuss community education and researchers' somewhat differing views on the impact of education. Chapter 4 presents the data set, while chapter 5 describes the discrete time hazard model and the variables used in the regression model. In chapter 6 the results of the regression are presented and discussed, followed by summary and conclusions in chapter 7.

2. The extent of child mortality in sub-Saharan Africa

2.1 The extent of child mortality

Infant mortality is defined as the probability of a child dying before the first birthday while child mortality is the probability of the child dying prior to its fifth birthday. In Sub-Saharan Africa, the average child mortality is 179 per 1000 live births and in some of the least developed countries in this region, one in four children die before the age of five (United Nations Human Development Report, 2003).

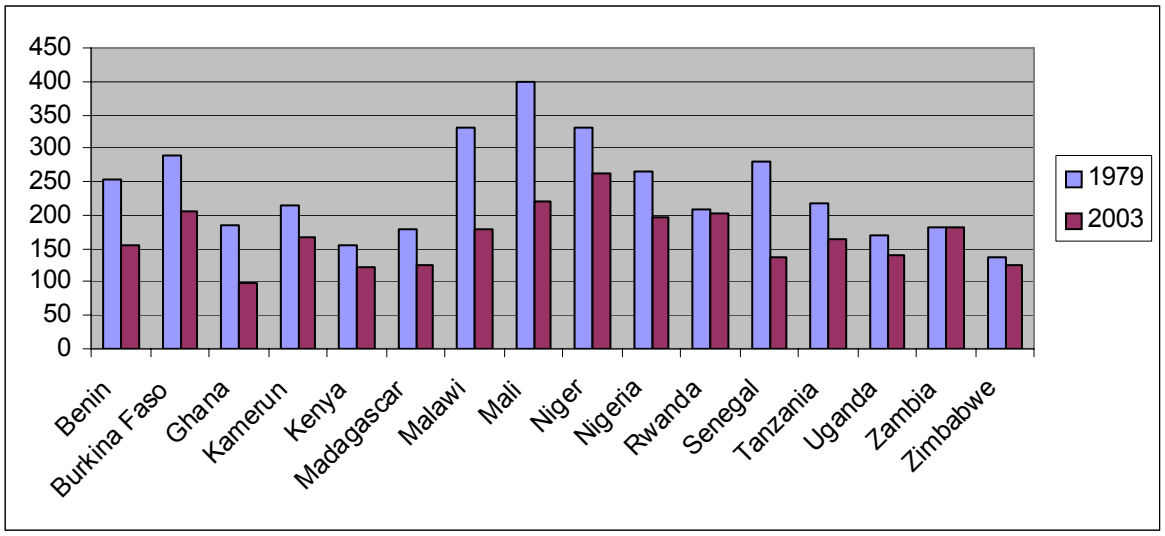


Figure 2.1: Mortality for under-five per 1000 live births (UN HDR, 2003).

According to WHO, seven out of ten deaths among children under five are caused by the following five diseases: Pneumonia and tuberculosis, diarrhoea, measles, malaria and malnutrition:

- Pneumonia and tuberculosis are the two main types of acute respiratory infections and are the leading cause of death among children under five. Acute respiratory infections are responsible for the deaths of over 2 million children in less developed countries today. Although these infections can easily be treated with antibiotics, it is crucial that the child is brought to a health clinic in the early stages of the disease.

- Diarrhoeal diseases are also responsible for over 2 million deaths worldwide and are generally caused by the consumption of contaminated water or foods. The most common type of diarrhoea is acute watery diarrhoea which can be treated by providing the child with fluids that contain a certain amount of salts, also known as oral rehydration therapy. Another diarrhoeal disease is dysentery, another result of the consumption of or exposure to contaminated water that can be treated with antibiotics. The final type of the diarrhoeal diseases is persistent diarrhoea, whose main cause is malnutrition, and which lasts for more than fourteen days. In sub-Saharan Africa the lack of access to clean drinking water causes a high prevalence of diarrhoeal diseases in the region.

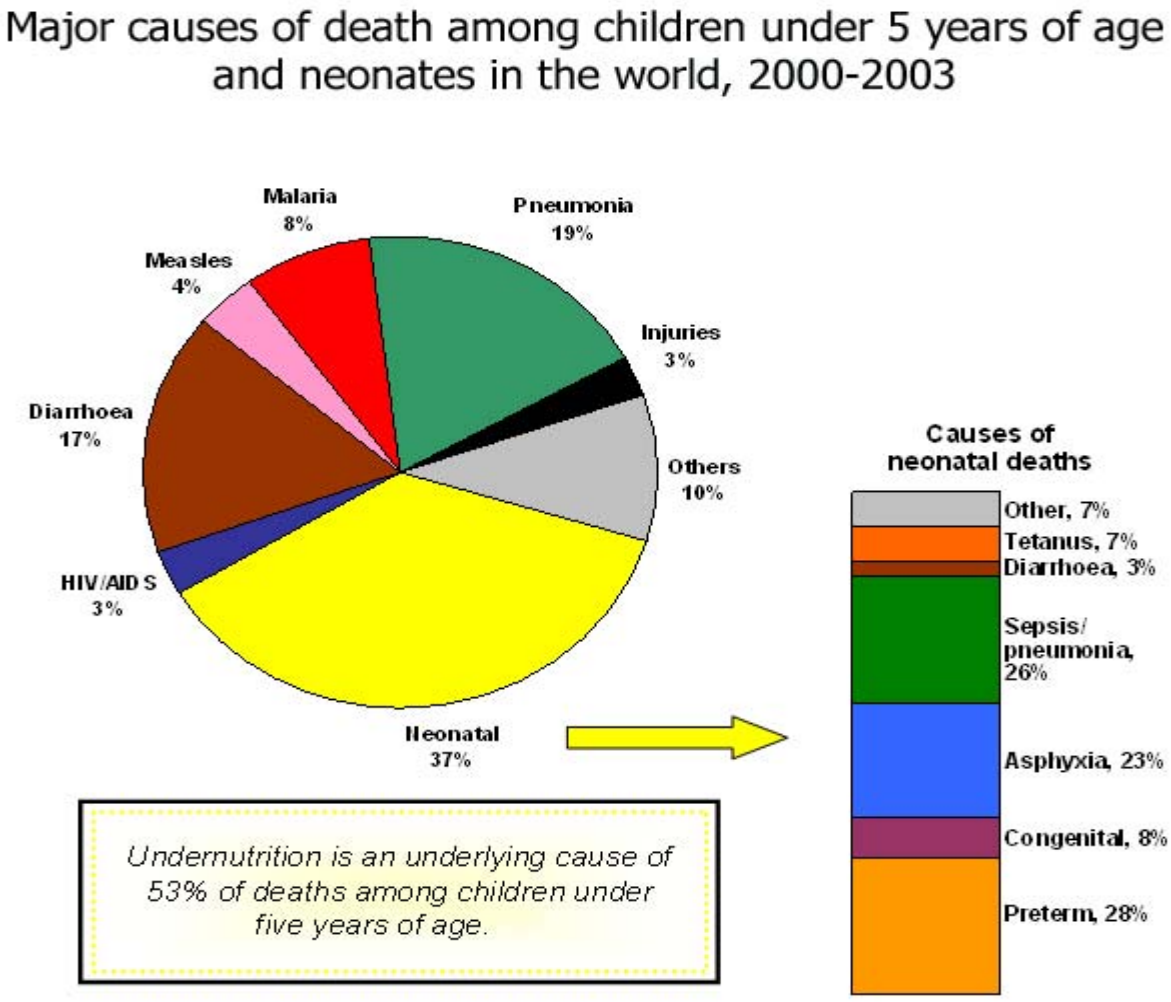
- Measles is a disease that has been eradicated in most of the world. Progress has been made also in the less developed countries, due to extensive efforts to promote immunization programs. Despite these efforts, 40 million are infected and 800.000 children under the age of five die from this disease each year. Measles are associated with diarrhoea and acute respiratory infections, and it can therefore be difficult to distinguish the main cause of death.

- Malaria is responsible for the death of 600.000 children every year, most of which is in Sub-Saharan Africa. The virus, which is spread via mosquitoes, can be prevented by using insecticide-impregnated bed nets and is treatable if the child is brought to a health clinic in time. It has been estimated that the total child and infant mortality rate would be reduced by 35 % if all families used bed nets. One of the problems with malaria and diagnosing it is that it may only cause a fever, which makes it hard to distinguish it from other diseases. As a result, the child may not receive the appropriate treatment immediately.

- Malnutrition is a factor in more than 50 % of all under-five mortality in less developed countries. It is seldom the direct cause of death, but it makes children more susceptible to other diseases and is thereby a main contributor to the high rates of child mortality in these countries. Malnutrition is a result of poor feeding practices, namely inadequate breastfeeding and the wrong foods in insufficient quantities. In order for a child to grow up in good health, it should be breastfed

for at least 4 months, and ideally for 6 months, before it starts to eat solid foods. It has been established that continuing breastfeeding until the age of two has a significant health benefit for children in less developed countries, provided that the child still wants breast milk in that period. Breastfeeding ensures that the child builds up an immune system that helps protect against diseases. If all children were to be breastfed for 4-6 months, this alone would bring down the number of deaths by 10%. However, there has been an increase in the use of infant formulas as a substitute for breast milk and bottle feeding in less developed countries over the last 10-20 years. This is an unfortunate habit, because of the lack of clean water, and one of the important tasks for health workers today is to recommend to mothers the beneficial effects of breastfeeding.

Figure 2.2: Main causes of child mortality (WHO – Child and Adolescent Health Statistics).



As always, the less privileged in the society are at the greatest risk, being the ones least likely to have access to clean water and the money to buy bed nets. Besides, the households living beneath the poverty line often consist of uneducated parents.

Furthermore, it is a problem that uneducated parents too often do not recognize the symptoms of deadly diseases and take their children to a health clinic for treatment. WHO estimates show that two thirds of all deaths among children under five can be prevented by simple low-cost interventions, through information and education of parents in general and mothers in particular.

In addition to the somewhat more "traditional" lethal diseases in developing countries, the HIV virus is spreading rapidly in sub-Saharan Africa, causing high mortality and inflicting severe stresses on society. As the possible impact of education on HIV-related mortality in particular is a part of my analysis, the following chapter describes the situation in the African region with respect to this virus.

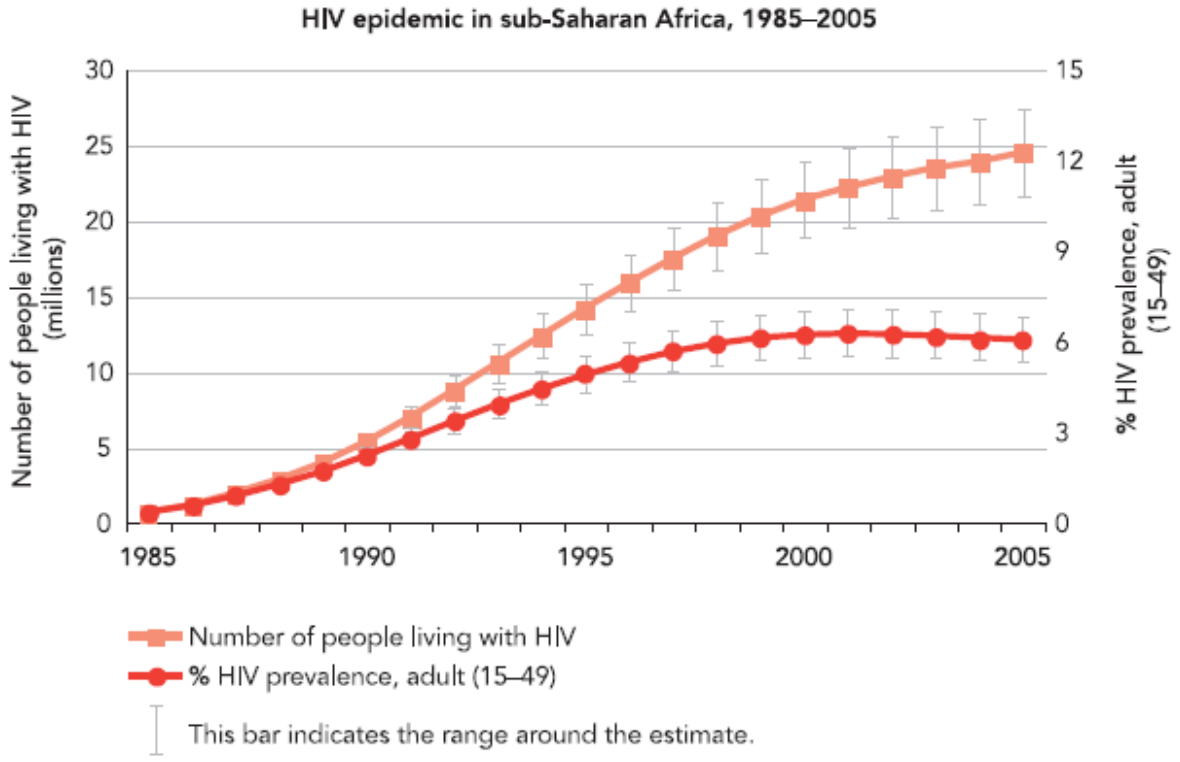
2.2 The HIV pandemic

One of the gravest problems facing Sub-Saharan Africa today is the high prevalence of HIV/AIDS. "AIDS is an autoimmune deficiency syndrome caused by the human immunodeficiency virus HIV, which is spread through blood, semen, vaginal secretions and breast milk" (Caldwell, 2002).

The HIV virus is responsible for bringing the life expectancy in some African countries down from an estimated 70 years without the epidemic, to less than 30 years (Stanecki, 2002). Formal education along with information through other channels such as family planning programs, local health workers, radio programs and soap operas dealing with these issues are considered important in fighting the spread of the disease.

Despite these efforts, the HIV prevalence in many Sub-Saharan countries continues to rise. Caldwell, however, claims in his article that as far as education goes, we have reached the limit because 95% of adults in sub-Saharan Africa are aware of HIV, know how it is transmitted and how to avoid it (Caldwell, 2002).

Figure 2.3: HIV trends in sub-Saharan Africa 1985-2005 (UNAIDS).



[2]Even though HIV prevalence rates have stabilized in sub-Saharan Africa, the actual number of people infected continues to grow because of population growth. Applying the same prevalence rate to a growing population will result in increasing numbers of people living with HIV.

The epidemic has reached devastating dimensions in many countries in sub-Saharan Africa, where 24.5 million people are currently living with HIV. 70% of the infections and 80% of the deaths from AIDS occur in this part of the world, and while the prevalence rates seem to be dropping in other developing regions such as south-east Asia, the rates in Africa are unchanged or increasing (Caldwell, 2002).

Over the past 5-10 years, HIV-prevalence rates have increased rapidly among women, and 59% of adults living with HIV in sub-Saharan Africa are now women. This increase makes children more exposed, as the mothers often are unaware that they have the virus during pregnancy and breast feeding. In some of the worst affected countries, as many as 35% of the women who visit prenatal clinics are infected with the virus (UNAIDS, 2006).

The reasons for the rapid spread of HIV in Africa are many. One obvious cause is the pattern of sexual behaviour. In Africa, mainly heterosexuals are infected, often as a consequence of polygamy. Also, the high fertility and following post partum abstinence is

considered by Caldwell (2002) to be a contribution to the spread of the disease, as the husbands in this period seeks other women to satisfy their sexual needs. The main problem, however, when addressing the sexual transmission of the HIV virus, is the lack of condom use.

Although AIDS is not the main reason for child deaths in sub-Saharan Africa, children are severely affected by the disease. According to estimates by UNAIDS' Global Report on AIDS 2006, 2 million children in this region are currently living with AIDS and 13 million have lost at least one parent to the disease. In the countries where the prevalence is the highest, more than 15 % of the children are AIDS orphans, and by 2010 is has been projected that 25 million children will be affected by HIV/AIDS.

Children who live in AIDS affected households or who are orphaned often lack proper nutrition and they do not receive sufficient medical treatment when they are ill. For example, they typically lack money for school fees and other economic support, and they do not get the emotional care they need. They may also get insufficient treatment for other infectious diseases such as ARI's and diarrhoea. Further, the children become responsible for the care of their sick parents. This is especially the case for girls and young women, and as a result they are not able to attend school which makes them more likely to end up in living conditions that make them more vulnerable to the disease in the future. Besides, AIDS orphans are at a particularly high risk of being exploited by others because they do not have a family to protect them. They may also tend to become exposed to a lot of social stigma and discrimination because AIDS is something that many people are afraid of and want to distance themselves from. In other words, many children die indirectly of the disease, in addition to those dying because they have contracted it themselves. (Stanecki, 2002; Lamptey et al, 2002).

3. Theory – The effects and determinants of education

Education is influenced by several factors at the community and individual level, and it may be that some of the education effect on mortality is reduced when we include some of these determinants in the model. In this chapter, I intend to explain some of the conditions that might have determined whether a woman has attended school and how these could affect the health of her family. I will also discuss how individual and community-level education may influence mortality, and as part of that address the issue of social diffusion and the impact that community-level education may have on AIDS mortality in particular.

3.1 The determinants of education

First of all, there are certain characteristics of a community that could influence education. Typically, a relatively rich community will be able to offer its members better education facilities, both with respect to quality and quantity. The degree of urbanization will also be a determinant of education. More people concentrated in a smaller area make the expansion of educational facilities easier and will often create a labour market that values education (Kravdal, 2004).

Furthermore, the political and religious attitudes in a community are important for the educational environment because these factors determine a woman's autonomy and hence the value of her getting an education. In a very conservative society it may not be acceptable to send daughters to school or for a woman to take a job outside the household as is the case in some countries e.g. in the Middle East. And if women are not allowed to take a paid job, then what is the point of families sending their daughters to school?

As for the individual factors that determine whether the woman has had the opportunity to get an education, the parents' wealth and attitudes are of great importance. Families with a relatively high income will have less need for their children to contribute to the family income, and will have a higher inclination to send them to school. It is also likely that when the parents themselves have an education they will tend to want the same for their children.

Children of uneducated parents may be given the opportunity to get an education as well because it may be beneficial for the entire family to invest in the children's education. In this case, however, girls are often discriminated against, since it is the boys who will stay close to the family and support them. The girls will, when they get married, often be

contributing to the family-in-law's income and hence their education is often considered to be a bad investment. The parent's attitudes on gender issues are especially important when they decide whether to send their daughters to school or not. Education and information are therefore important factors in dealing with such gender inequalities.

On the other hand, it may be that an educated daughter has a higher probability to marry an educated man, and is therefore able to live in a more prosperous environment. This could affect the parents' decision whether to send a daughter to school or not.

On a macro-level, it can be claimed that if the women's position in society is weak and her family is poor, the incentives for these families to send their daughters to school are small. There just is not a high enough payoff for the individual family in investing in a girl's education. When the girls eventually get married, it will be her in-laws who get all the pay-off from her education anyway. Hence, a woman's status and autonomy could have implications for the mortality of her children, both through the lack of education and because of the fact that she is not part of the decision-making in the household.

Finally, it is possible that a girl's family decides to send her to school largely because many other children attend school. This can be seen as an imitation of behaviour in order to avoid the disapproval of other community members.

The lack of control for such possible confounding variables in many earlier investigations is what concerns Desai and Alva in their study (Desai and Alva, 1998).

The authors argue that educated women tend to come from higher socioeconomic strata of the population, and that they often live in more advantageous areas with respect to economic development. With high economic development comes higher incomes, better public finances and hence better educational and health facilities. This may explain the assumed causal relationship between a mother's education and her children's probability of dying young.

In their analysis of child mortality, they add community fixed effects in order to exclude all possible features of a community that may influence a woman's education and her children's probability of dying. This approach leads to a significant reduction of the effect that a mother's own education has on child mortality rates. The problem with this approach, however, is that by excluding all community variables, they also exclude the possible effect of other women's education on child mortality.

3.2 The impact of education

3.2.1 Individual-level effects of education

A woman's own education influences her children's health through several mechanisms. First of all, she gains crucial knowledge on subjects like hygiene and nutrition, which is beneficial for her family's health (Kravdal, 2004). She is also more likely to know about the importance of breastfeeding her children, and at what time her children ideally should start eating solid foodstuffs (Palloni, 1986).

Several studies have confirmed that children whose mothers have attended school are more likely to take part in immunization programs that prevent lethal children's diseases such as smallpox, diphtheria, poliomyelitis and tuberculosis (Streatfield, 1990).

Another advantage associated with the education of women seems to be that their children tend to receive medical attention in case of illness more often than what is the case for children of uneducated mothers. Studies have shown that children with diarrhoea are more likely to get help in form of oral rehydration therapy if their mothers have undertaken formal schooling (Sandiford et al., 1995), and they also have a higher probability of being taken to a health clinic if they develop a fever or serious respiratory diseases.

Furthermore, even a low level of schooling enables the women to communicate better with health care workers, both in the prenatal and the neonatal stage of childbearing. This means that they are more likely to receive the help of a midwife during birth, and to get advice as how to best provide for the new-born child in the first months after birth (Sandiford et al., 1995; Kravdal, 2004).

When discussing the impact of education on child mortality, the fertility issue is impossible to neglect as there are several direct effects of the reproductive pattern in a family on its children's health (Kravdal, 2002). Even after only one year of schooling, a woman's birth rate tends to decrease (Cleland and von Ginneken, 1988). A smaller family size can be beneficial for the entire household, because its limited resources will be shared between fewer people and there is also a lower chance of infections spreading, since there are fewer individuals exposed and at risk of exposure.

The health of the child is naturally also dependent on its mother's health and while a pregnancy always is a health risk, there is an increasing risk of maternal depletion for higher order children. This is especially the case if the children are born within a short space of time. The use of contraceptives is therefore important as a way to help couples with the spacing of births.

Many women become pregnant while still breastfeeding their infant child, often due to the belief that breastfeeding is a contraceptive in itself. This short spacing of births may also affect the ideal breastfeeding time of the second youngest child and hence reduce its immune system.

Giving birth is such a strain on a woman's body, that a shorter spacing of births than 1,5 – 2 years is too short a time for the body to recover from the last birth. Especially if the family is poor, the mother may not have had the chance to recover from the last birth. When maternal recovery time is reduced, the birth weight of the second child is often low. In addition to this, children born with a short interval will often compete over the family's limited resources.

The ability to communicate with health workers and medical staff is likely to increase the use of birth control as educated women are better informed of available family planning methods and are more likely to use them to adjust the number of children to obtain their desired family size (Kravdal and Moursund, 2003). This desired number of children will naturally differ from family to family and is itself influenced by the mother's and father's education. In other words, education affects both the actual number of children and the interval between the births.

The desire for children is also influenced by education. With an education, women are more likely to join the labour force and work outside agriculture. The higher the education, the higher the income and hence the alternative costs of having children increase (Hess and Ross, 1997). A mother with a well paid job is more reluctant to have many children and this effect of women's education and subsequently their increasing participation in the work force has contributed much to reducing the fertility in industrialized countries.

Education works through many other channels that can influence the well-being and the survival of small children. One of the tendencies seems to be that educated women get married at a higher age than women with little or no education. Possible reasons for this could be that they want to finish their education before they get married and have children or that with an education they get more particular when choosing a partner. Their autonomy is probably increased as a result of the education as well, and they are freer to choose a desired partner. This increase in a woman's age at marriage is of importance for the child mortality rate because it increases her age at first birth, which in turn is beneficial for both mother and child. Furthermore, a relatively high age at first birth will also affect the total number of children.

Studies have shown that young mothers have a higher probability of experiencing complications during child birth, and the mortality rate of children born to young mothers is significantly higher than for those who give birth at an older age. Generally, women who give birth when they are below 20 or above 40 years of age have a higher mortality rate with the obvious deterring effects on their children's health (Hobcraft, 1993).

A woman's autonomy has been proved to have an impact on her children's health. (Kravdal, 2004) If the general position of women in a society is low, there will not be as high an acceptance for girls to go to school as there would be in a society where a woman's status is high. When these girls grow up, their lack of education may affect their autonomy as adults which in turn will have an impact on their children's health. This effect is especially important in countries where women's status is known to be low, e.g. the Middle East, and it is manifested through the high mortality of their children. When a mother has little or no education, her ability to speak up in issues concerning her children and their upbringing will not be given much attention compared to that of, for example, her husband or her mother-in-law.

Jejeebhoy (1998) considers a woman's aspects of autonomy to consist of her physical autonomy, i.e. her ability to go where she wants to whenever she wants to; her economic autonomy, i.e. whether she is being heard in discussions on how to spend the family income; and her decision-making autonomy which considers whether she has a say in decisions that are being made in the family, e.g. whether a sick child should be taken to a clinic. A woman's autonomy is probably a more relevant issue in the Middle East, Northern Africa and in East Asia, but there also exists substantial gender inequalities in sub-Saharan Africa.

A woman's education influences her chances of marrying an educated man. The effect of the husband's education has not been paid much attention in studies of child mortality, but it is a fact that an educated man has a tendency to marry an educated woman and hence their children are more likely to survive. It is possible, however, that the husband's education influences the mortality of his children through such mechanisms as his attitudes towards gender issues in the household. On the other hand, it has been shown in some studies (Cleland and Rodrigues, 1988) that the effect of a man's education on fertility is positive. Although this is not well established, it seems that with a better paid job, the fertility desires of the husband tend to increase, as opposed to what is normally the case for educated women in well-paid jobs. This could be due to the fact that when a man has a better paid job, he is able to provide for a larger family, while a woman experiences an alternative cost of child

rearing because she has to give up her job while caring for the children. It may also be that a man considers the ability to be a breadwinner for a large family a sign of his success.

Finally, it should be noted that one may also detect *harmful* effects of education. Educated mothers have been observed to breastfeed for a shorter period of time, and there could be a similar effect at the community level. A community where there is a higher acceptance for women to take paid work in the modern sector could influence breastfeeding norms and child care in general since these jobs seldom allow mothers to bring their children to work.

3.2.2 Community-level effects of education

While all the arguments above consider the individual effects of education, it may also be that the level of education in the community has an impact on the individual woman's chance of losing her child.

Lately, the subject of community education, i.e. other women's education, has been brought up as an additional argument for education as an important and independent determinant in reducing child mortality. Community-level education was originally proven to have an impact on a woman's fertility preferences and on the use of family planning methods (Bongaarts and Watkins, 1996; Montgomery and Casterline, 1996; Kravdal og Moursund, 2003), but it can also be assumed to be a factor in mortality decline and a factor that influences maternal education and child health.

It has been suggested that in order to see the entire effect of education, one can not limit education effects to concern only the individual level. It is also important to look at education on an aggregated level, in the form of community-level effects (Kravdal 2004). In the study by Kravdal (2004), the impact of community education is assessed by including in the models the average education for the women living in a census enumerated area (or a cluster).

Community level effects of education could for instance entail a beneficial imitation of behaviour. If all the other parents take their children to the doctor when they are ill, you will probably take your child too. It may also be that more people in the community learn from their peers, and by learning and not only imitating others, they become more well-informed about good health behaviour. As a result, they are for example less likely to believe that sickness is caused by the wrath of something divine, and more likely to get medical help if someone in the family is sick. When a certain attitude is passed on from members of the community who have attended school to those who have not had this opportunity, there is a

type of social diffusion of knowledge at work. According to social diffusion theory, which is more thoroughly discussed in the following subchapter, educated women in a community influence not only their own children's health, but also the health of children born to uneducated mothers.

This social diffusion of knowledge may result in the improvement of nutrition as well as an increase in the prevalence of vaccination, a more hygienic environment, and a more appropriate home care in case of disease. A generally higher level of education among women could also eventually strengthen their position in the community and contribute to a higher degree of gender equality (Bongaarts and Watkins, 1996; Kravdal, 2004).

Besides, educational expansion may lead to economic transformations and a wealthier community. This might, in turn, increase investments in sanitation and health care facilities, and thus have an impact on the child mortality in the area. As a result of the increased number of educated community members, political attitudes will probably change as well.

Also, a generally higher level of education among residents in a community could lead to fewer diseases among children and adults, which in turn mean that less people are infected and that there are less people to get a contagious disease from.

There can be reasons to believe that community level education has an impact on the specific AIDS-related mortality risk. It may be that the opinion and experience of others in the community have an impact on the inclination to use condoms and take precautions in sexual relations. As an example one may consider a community where some of the people have a relatively high education and are well-informed of the risks of getting HIV. The educated community members will probably have higher incomes and more power in society and this makes them able to influence the views that the less educated may have on subjects such as contraception use and sexual behaviour. In this way, the average education level could have an impact on HIV-prevalence and AIDS mortality in particular, because there are such easy measures that can be taken to avoid the spread of the disease. If a higher level of average education among the community members can lead to an increase in income and also a change in attitudes and norms, it may be that it is possible to make people take fewer risks when it comes to sexual relations.

For these reasons, it is possible to expect specific effects of education on AIDS mortality. Whether this effect exceeds the effect on general mortality, however, is difficult to say, and I will therefore include variables in the models to see if there exists such a pattern.

3.3 Diffusion theory

"Diffusion refers to the process by which innovation spreads among regions, social groups, or individuals, often apparently independently of social and economic circumstances." (Bongaarts and Watkins, 1996)

The theory of social diffusion was first introduced in demography when researchers studying reproductive behaviour had problems explaining the patterns of change based solely on the individual's socioeconomic characteristics. The social diffusion of ideas and information is widely assumed to have contributed to the fertility transition that took place in Europe in the late 19th century. Studies have shown that once a region in a country had begun a decline in fertility, the neighbouring regions with the same language or culture were soon to follow, regardless of the levels of development. This did not fit the existing theories about the demographic transition, and demographers started considering the social interactions that connect people (Bongaarts and Watkins, 1996).

According to Bongaarts and Watkins (1996), social interaction can be separated into social learning and social influence. Social learning implies that learning about other individuals' experiences may change the behaviour of an entire network. This could have an impact on the general behaviour among community members which again may influence a region, and in the end it could have effects on an aggregated country level. As an example, let us consider women with some education that practice breastfeeding their children for at least a year. Through the conversation with other women with or without an education, they may change the breastfeeding behaviour of many mothers in the community. If some of these women pass on their knowledge to women outside the community, it may change the rules of breastfeeding in an entire region. This will have a positive effect on the children's health and will reduce the child mortality in the entire region.

Information from other people in the community, conversations with individuals within their own network or information through programs such as clinics and the media are examples of how people are exposed to social learning. The conversations often take place among men and women who are similar with respect to socioeconomic status and culture. This conversation within the network is highly valuable as they translate information and ideas so that they become more meaningful in a local context. If a member of the social network tells her co-members of, say, a family member who has been breastfeeding her children for 9 months, and that the children are in good health, this will serve as a reason for the other women also to breastfeed.

Social influence implies that, as a way of getting approval from other people in the community, norms, opinions and behaviour in a social environment will tend to diffuse among its members. The participants of a social network will change their behaviour in order to get approval from their peers or other people in the community with more power than themselves. There may also be a fear of being considered different and having others disapprove of their behaviour. In this setting, people will tend to gossip in order to test the reaction to certain types of behaviour without being exposed to any risk of disapproval. The mere observation of other people behaving differently can be thought to trigger a change in behaviour.

Social interaction can take place on a local level, a national level and even globally. The channels of interaction on a local level can be a consequence of a spatial or a social proximity among the network members, i.e. neighbours or job colleagues. On a more aggregated level, these channels serve as a connection between communities. It is rarely the case that a community is completely isolated from the outside world. Someone could have a family member living in another village, some people work outside the community and through these channels of interaction information and ideas are brought to the community.

Local channels of interaction consist mainly of personal networks where information and ideas are shared and evaluated, and these will either be approved or disapproved of. Geography and language are considered to be the main determinants of these types of personal networks. Economic development is also an important determinant in that it leads to social differentiation. Differentiation between socioeconomic groups and between people in different occupations is necessary in order to form so-called heterogeneous networks that are thought to facilitate innovation.

Education is another factor in the creation of personal networks, because educated people tend to get a job outside of agriculture and may even have to move to a larger city. In this way, the geographical range of the network is expanded.

What would typically characterize a network that could have an impact on child mortality? Let us consider a network that includes one or several educated women. If these women have some amount of schooling, they will probably know about the importance of breastfeeding and immunization, and they are more likely to contact a clinic when their child is ill. Through the social interaction with the other women in the group, including uneducated mothers, they will probably recommend this type of behaviour, which in turn may encourage the other mothers to do the same for their children.

The network in the example above is a typical heterogeneous network. These are networks that exist despite of the boundaries represented by geography, ethnicity, wealth, education and gender. They are formed when people who would not normally interact are "forced" to spend time in each other's company, i.e. at work or in school. It can be a type of group like the one mentioned above, or it could consist of families where one or several members are season workers and travel a lot. In the heterogeneous networks, there tend to be a greater acceptance for new ideas and the members are more likely to absorb information that can influence their behaviour.

While the heterogeneous network consists of people who are different in some respect, a homogeneous network often consists of relatives, neighbours and people of the same gender who come from a similar socioeconomic background and belong to the same ethnic group. In this type of network there tends to be less acceptance for socially "deviant" behaviour, e.g. gender issues. These networks will also be less informed of new ideas, since their group consists of people in close relation to each other and because they will tend to just pass the old news around with the result that no innovative behaviour will come as a result of it.

There is also a question of the ideal density of a social network. Watkins et al. (2001) argue that the social learning is maximized when the structure of the network is so sparse that the people in the network have a minimum of interaction with each other and mainly serve as independent sources of information. The reason for this is that very dense networks can have a tendency to have too great a normative influence on the network members. If the network members are too close to one another and especially if some of them have some kind of excess power over the others, they could encourage or discourage certain ideas and innovations as they pleased, and it would be difficult to make a change that could in other ways have helped prevent child mortality.

On a national level, the channels of social interaction are mainly economic activity, infrastructure and culture. Economic growth in another geographic area could create job opportunities and lead to migration of some of the network members. An improved infrastructure facilitates correspondence with and visits to members of the social network who live in a different geographic area. The access to such media as radio and TV is also an important transmitter of ideas and information on a national level.

In addition to the local and national channels of social interaction, there is the interaction on the global level. This transmitting of ideas happens for example through those who study abroad, multinational companies who establish themselves in a country or

international organizations such as the UN or World Bank or NGO’s program efforts in a country.

4. Data

4.1 The dataset

My data were arranged by Øystein Kravdal and are from the Demographic and Health Surveys, which are run mainly through the funds of USAid. DHS are nationally representative household surveys with large sample sizes (usually between 5.000-30.000 households). Some of the main objectives of the DHS projects are to expand the international population and health database in order to help decision makers in the developing countries make well informed policy choices.

Among other things, DHS collects data on child health and mortality, through such indicators as vaccination, the prevalence of acute respiratory infections (ARIs) and fever, and diarrhoea. They also include data on maternal mortality, social and economic factors, breastfeeding habits, the prevalence of HIV and the population's knowledge of how to protect themselves from HIV and other sexually transmitted diseases.

The surveys use a clustered sample, which means that each province or region of a country is divided into small census enumeration areas. These areas cover one or a few villages or settlements, a small town or part of a larger town or city and usually include about 1000 people. Within each area, about 25 women of reproductive age are interviewed (about 10% of the women of representative age in the area) and constitute a " cluster". There were more than 5000 of these clusters in my data set.

In my analysis I have used data for the following countries: Benin, 2001; Burkina Faso, 1999; Cameroon, 1998; Ghana, 1998; Kenya, 1998; Madagascar, 1997; Malawi, 2000; Mali, 2001; Niger, 1998; Nigeria, 2001; Rwanda, 2000; Senegal, 1997; Tanzania, 1999; Uganda, 2000; Zambia, 2001; Zimbabwe, 1998.

In the surveys, about 125.000 women aged 15-49 were interviewed. The observations in the present analysis are restricted to only include children with mothers who were currently married at the time of interview and only children born less than 5 years before the interview were included.

The study takes into consideration the woman's educational level at the time of the interview, her religion, whether her place of residence is an urban or rural area, her birth history, the wealth of her household, and the average education in her community.

5. Discrete-time hazard models

5.1 Methods

Event history analysis is a commonly employed method in demography and other social sciences. It is used to find out how frequently certain important events occur. In demography, an event is considered to be a change that serves as a sharp distinction between the previous state and the current state. An example of an event in demography is the transition from being childless to giving birth, from being married to being divorced, and the most distinct one of them all, from life to death (Allison, 1984).

A common problem with demographic data is that of censoring. We know that an event has not taken place until the end of our follow-up (for example the time of interview) but not whether it happens afterwards. It is not even certain that everyone will experience the event. Another problem is that the explanatory variables may change over time. In event history analysis, the problems of censoring are nicely handled, and it can be taken into account that some of the explanatory variables change over time.

There are two versions of event history analysis that might be applied; discrete and continuous time hazard regression. In this analysis I have chosen to use discrete time. In a discrete-time hazard model, it is separated into intervals, and in each interval, certain relevant explanatory variables are observed as well as whether the individual experiences the event or not. More specifically, at the beginning of each 6 month interval, the variables are updated and it is checked whether the event (in this case child death) has occurred or not. The dependent variable for child mortality is denoted z. If, at the end of a 6 months interval, the child is still alive, the value of $z = 0$, and the observation stays in the data the next 6 months when it is checked again. If, on the other hand, the child has died, the dependent variable z equals 1, and the follow up ends. There is a probability P of the mother experiencing the death of one of her children in a given interval of time. In this model for child mortality, the starting time is the time of birth, while the observations end either when the child dies or at the time of interview. A length of 6 months is chosen for the time intervals, which is considered short enough because we get approximately the same results when using shorter intervals. This is also a convenient interval length to work with since the total number of intervals becomes relatively small.

The variables that are included in the models are the age of the mother, her education, the average education in her census enumeration area, her religion, whether her household has electrical power and her place of residence. These variables are for the larger part assumed to be constant over time. Twins were excluded.

I assume that the child mortality within 6 months is given by the following logistic expression where x are the independent variables and β represent the effects of all the right hand side variables:

$$\ln \frac{P}{1-P} = \beta \cdot x \qquad (6.1)$$

If the estimated beta is negative for, say, the education variable, then an increase in education contributes to a reduction in the probability of the child dying. As an example, consider an estimated beta of – 0.45 for the education level 9-10 years of schooling compared to 0-2 years (the reference group). In order to see how much this reduces child mortality, we insert this number into equation (6.1):

$$\ln \frac{P}{1-P} \text{ is reduced by -0.45 } \Rightarrow \frac{P}{1-P} \text{ is reduced by } 1 - e^{-0.45} = 0.36$$

This reduces P by approximately 36 %. In other words, if the mother has completed 9-10 years of formal education, her child's probability of dying is reduced by 36 %. The exact reduction depends on P, which has the implication that it is also determined by the level of the other variables, but the smaller the P is, the closer the reduction is to 36% in this example. These logit regression models are estimated in SAS by the maximum likelihood method.

5.2 The variables[1]

The age of the mother

The mother's age when giving birth is assumed to have a significant effect on her child's probability of surviving. This is due for example to the fact that young mothers more often tend to experience problems during pregnancy and also when giving birth.

[1] Data on the husband's education were not available in my data set.

The year and boy variables

It is a fact that boys have a biological disadvantage when it comes to surviving infancy. If there is a tendency towards excess mortality among girls in a region or a country (i.e. the coefficient of the boy variable being close to zero or even negative), it could indicate a discrimination of girls when it comes to preventive and treatment health care. This has been proven to be the case in some countries in the Middle East and in South Asia (Mishra 2004), where the status of women is low and where the parents have greater incentives to invest in a boy's survival than that of a girl. In these African countries, however, this does not appear to be an issue, and part of this may be contributed to the fact that women's autonomy is somewhat higher in sub-Saharan Africa than it is in for example the Middle East. According to this, there should be a small positive effect of the boy variable on child mortality. Although this is not a relevant variable with respect to the effect of education, it can provide us with information about women's status in an area, and is therefore included in the models.

There has been a general expansion of education in Africa during the period when the surveys were held (1990-2001), partly because improvement of educational facilities or that girls' education was made an important issue in development programs. Therefore, a low mortality among educated mothers could in principle reflect that these women tended to be among those included in the latest survey, held at the time when mortality would be lower for completely different reasons (better health care, more solid economy etc.). The calendar year is therefore included as a control variable in the model.

Education

The level of the mother's education has been separated into four intervals, where the lowest level (0-3 years of education) is set to be the reference category. The next categories are an uncompleted primary schooling of 4-6 years, a completed primary education or an incomplete secondary education (less than 2 years, in sum 7-8 years), 2-3 years of secondary education (a sum of 9-10 years), and a secondary schooling of more than 4 years (11+ years in total education).

Religion

This variable has been separated into three groups; Muslims, those with traditional beliefs and those with other or no religious beliefs. Religion may have an impact on a woman's autonomy, her level of education and hence on her family's wealth. It may also influence the attitudes towards family planning and birth control.

Years of education

This variable has been included in two of the models in order to capture the linear effect of the mother's own education and therefore to see more clearly the total impact of (potential) educational improvements. Its parameter describes the effect on child mortality from one more year of education.

Average education among women

As a measure of community education, I use the average number of years of completed schooling by women in a given census enumeration area (Kravdal, 2006).

The wealth indicator

A wealth index has been created by summing up the ownership of the following consumer items: bicycle, motorcycle, car, radio and television. Such indices are, according to Bollen et al. (2002), reliable proxies for the economic status of the household. The wealth of a household is clearly related to the child mortality rate through factors such as hygiene, sanitation facilities and the child's living standards as a whole. It is also more likely that the mother in a wealthy household is educated due to reasons listed in the previous chapters. As for the causality between education and wealth, there is considerable ambiguity, so we cannot really be sure whether we pick up a confounding factor or a causally intermediate one (i.e. tap out some of the total effect of education). On the one hand, education has an impact on the income of the household and thus the wealth at interview. On the other hand, her household's current wealth may reflect the economic resources in the woman's family of origin, which in turn have contributed to determine whether she has an education or not (Filmer and Pritchett, 1999).

Electricity

The electricity variable is an additional way of incorporating into the model the effect of housing standard on child mortality. In the same way as the wealth indicator, whether the household has electricity or not can be used as a control variable. The electricity variable and education variable are connected in the same way as has been described for the wealth variable. There are many other possibilities for determining housing standards, e.g. type of roof, type of floors etc. but I did not experiment with such alternatives.

Whether place of residence is urban or rural

I have also included a dummy variable which is 0 if the individual resides in a rural area and 1 if the individual lives in an urban area. It is likely that a woman who lives in an urban area has a lower probability of losing one of her children. This can for example be due to the higher availability of health clinics. But the urban variable is also linked with education, since a woman's probability of having an education is greatly influenced by where she grew up and where she currently lives. Furthermore, educated people tend to move to urban areas where the probability of obtaining a job in the modern sector is higher. In this study, due to lack of data, it is only possible to see the effects of the woman's *current* place of residence.

The country variables

Inclusion of country dummies allow us to check for country effects on child mortality that are not picked up in any of the other explanatory variables. This may include such factors as GNP, the geographic location of the country (there is definitely a difference between countries that are situated close to the Saharan desert and those in the south eastern Africa where the soil is much more fertile), and the extent of the AIDS pandemic.

HIV-prevalence

The prevalence of HIV in the country is included in one of the models, not as a main effect but in interactions with individual and community education. The intention is to check whether the education effects are particularly strong or weak in countries where AIDS is a common disease and where children therefore also have an especially high chance of dying from AIDS or AIDS-related conditions. Put differently, we use this interaction to find out - in lack of data on the actual causes of death - whether education has another impact on AIDS-related child mortality than on other causes of death at this age.

5.3 Possible methodological problems

All individual variables refer to the situation at the time of the interview and this is also the case for the variables for the community in which the woman lived at the time. We are interested in the mother's own education and the education of other mothers in her area, and how this affects the mortality of her children. Ideally, we should know the mother's and the other women's education at the time the child was born. However, the mothers that have

been interviewed have children that are up to 5 years old at the time of interview, and it is possible that the mothers' characteristics have changed after their children were born. Although a woman in sub-Saharan Africa is not very likely to attend school after having given birth, this is a possible weakness in the method. It could also represent a problem that the educational level of the woman and her socioeconomic status may have been determined in part by whether she has experienced child death.

The fact that many of the women may have moved during the last 5 years, i.e. lived in another place at the time of birth and early childrearing than at interview, may also, in principle be a problem

A final problem is that there may be unobserved community factors influencing both community education and individual mortality in the same area. As an illustration, let us compare a woman who lives in an area with a high average level of education to a woman in an area with a much lower level of education, and also assume that the community characteristics we can observe are similar. We also assume that they have the same education and are similar with respect to other individual characteristics. We can not be sure that any variation in child mortality is as a result of the difference in average education level. In the area with high average education there may also, for example, be other gender norms and another general level of wealth than in the areas with a less educated population.

6. Results

In order to capture the effects of the different independent variables on child mortality, I have estimated 4 models, and incorporated new variables for each model (Table 6.1.). In Model 1, in addition to the variables for the mother's age, year of interview and whether the child is a boy or a girl, I have included the mother's own education. Model 2 is expanded to include her religion and the two variables that tell us something about her socioeconomic status. All three are likely to influence education (for reasons mentioned in chapter 3 and 5) as well as mortality and therefore need to be controlled for. Model 3 is estimated to see if there is an additional effect of whether she lives in an urban or a rural area, while the variable for other women's education is included in Model 4.

First of all, it is obvious that the age of the mother is relevant for her child's risk of dying. A mother of age 15-19 has a 69% ($e^{0.53} = 1.69$) higher odds of losing her child in every 6 month-interval than one who is 20-24. The estimates also confirm that boys have a slight biological disadvantage compared to girls when it comes to surviving their first year. This indicates that any possible discrimination of girls is not large enough to counteract the biological disadvantage of boys.

The effect of education on child mortality in Model 1 is significantly negative, as expected. The higher the education, the lower is the mortality. The effect of education is reduced when I include variables that indicate the mother's social background and her family's wealth (Model 2).

The Muslim variable has a significant positive effect on child mortality. According to the regression results, the child mortality rate increases by approximately 28 % if the child is born to a Muslim mother. This could be a result of the fact that women's status and autonomy tends to be weaker in Muslim families. An indicator of women's autonomy is not included in this regression due to the lack of data but the effect is probably captured somewhat in this particular religion variable. Traditional religion or other beliefs has no significant effect on child mortality in this model.

The effects of electricity and wealth are very strong. This is of course due to the fact that wealthy households with electricity and a high number of consumer items are able to raise their children in better conditions.

In model 3, I have included the dummy variable for whether the woman resides in an urban area or not. The effect of this variable is negative and significant, but its inclusion reduces the effect of individual education very little.

After including average education in Model 4, the effect of a woman's own education is further reduced (and the beneficial effect of living in an urban area is wiped out). The total education effect, however, is strengthened. This can most easily be shown by including a linear effect of individual education instead of the categorical one. The estimates from that model are presented in Table 6.2.

Without the variable for other women's education, the parameter for years of education is -0.044. This means that with for example 10 years of schooling, the total effect is -0.44. When I include average education among women, the variable for years of schooling is reduced to -0.023 which amounts to -0.23 if the woman has spent 10 years in school. In addition to this, however, comes the effect of community-level education whose parameter is -0.05. This entails an effect of -0.50 for 10 years of education. The total effect of education is found by summing these two parameters (-0.73), which exceeds the effect of 0.44 predicted from the model with only individual education included.

After estimating these models, it is possible to conclude that in addition to the effect of the mother's own education, other women's level of schooling has a significant impact on child mortality in these African countries.

Table 6.1. Effects (with standard errors) of education and socioeconomic variables on child mortality in sub-Saharan Africa.

	Model 1		Model 2		Model 3	
Age of mother						
15-19 years	0.53***	(0.02)	0.52***	(0.02)	0.52***	(0.02)
20-24 years ²	0	-	0	-	0	-
25-29 years	-0.21***	(0.02)	0.20***	(0.02)	-0.20***	(0.02)
30-34 years	-0.25***	(0.02)	-0.24***	(0.02)	-0.23***	(0.02)
35 + years	-0.32***	(0.02)	-0.30***	(0.02)	-0.30***	(0.02)
Year	-0.02***	(0.002)	-0.02***	(0.002)	-0.02***	(0.002)
Boy	0.10***	(0.01)	0.10***	(0.01)	0.10***	(0.01)
Mother's education						
0-3 years ²	0	-	0		0	-
4-6 years	-0.24***	(0.02)	-0.14***	(0.02)	-0.13***	(0.02)
7-8 years	-0.48***	(0.02)	-0.35***	(0.02)	-0.34***	(0.02)
9-10 years	-0.70***	(0.04)	-0.47***	(0.04)	-0.45***	(0.04)
11+ years	-0.94***	(0.04)	-0.63***	(0.05)	-0.62***	(0.05)
Average education among women (years)						
Religion						
Muslim			0.25***	(0.02)	0.26***	(0.01)
Traditional religion			0.05	(0.03)	0.04	(0.03)
Other/No religion			-0.06	(0.03)	-0.06	(0.03)
Electricity			-0.32***	(0.02)	-0.26***	(0.03)
Urban					-0.12***	(0.02)
Wealth index			-0.09***	(0.008)	-0.09***	(0.008)

¹ Constant term is not shown.
² Reference category
p* < 0.01; **p < 0.001; ** p < 0.0001

Table 6.1 continued.

	Model 4	
Age of mother		
15-19 years	0.52**	(0.02)
20-24 years ²	0	
25-29 years	-0.20**	(0.02)
30-34 years	-0.23**	(0.02)
35 + years	-0.28**	(0.02)
Year	-0.02**	(0.002)
Boy	0.10**	(0.01)
Mother's education		
0-3 years ²	0	
4-6 years	-0.03	(0.02)
7-8 years	-0.18***	(0.025)
9-10 years	-0.26***	(0.04)
11+ years	-0.40***	(0.05)
Average education among women (years)	-0.054***	(0.004)
Religion		
Muslim	0.18***	(0.016)
Traditional religion	-0.008	(0.03)
Other/No religion	-0.08	(0.03)
Electricity	-0.20***	(0.03)
Urban	-0.04	(0.02)
Wealth index	-0.10***	(0.015)

¹ Constant term is not shown.
² Reference category
p* < 0.01; ** p < 0.001; *** p < 0.0001

Table 6.2. Effects of one additional year of individual level education among women.

	Model 5		Model 6	
Age of mother				
15-19 years	0.53***	(0.02)	0.53***	(0.02)
20-24 years ²	0	-	0	-
25-29 years	-0.20***	(0.02)	-0.20***	(0.02)
30-34 years	-0.24***	(0.02)	-0.23***	(0.02)
35 + years	-0.30***	(0.02)	-0.28***	(0.02)
Year	-0.02***	(0.002)	-0.02***	(0.01)
Boy	0.10***	(0.01)	0.10***	(0.01)
Effect of one more year of education	-0.044***	(0.002)	-0.023***	(0.0027)
Average education among women (years)			-0.05***	(0.004)
Religion				
Muslim	0.25***	(0.02)	0.17***	(0.02)
Traditional religion	0.03	(0.03)	-0.02	(0.03)
Other/No religion	-0.07	(0.03)	-0.094	(0.03)
Electricity	-0.26***	(0.026)	-0.21***	(0.02)
Urban	-0.12***	(0.02)	-0.04	(0.02)
Wealth index	-0.09***	(0.008)	-0.097***	(0.008)

¹ Constant term is not shown.
² Reference category
* p < 0.01; ** p < 0.001; *** p < 0.0001

In Models 7 and 8 (Table 6.4), I have included interactions between HIV-prevalence in the country and the education variables, which makes it possible to determine the effect of education on AIDS-related mortality. Although only the parameter for the interaction between the lowest educational level and HIV seems to be significant, it is possible to draw some conclusions from the estimates. The interpretation of the results is as follows:

For a HIV-prevalence of 0, the effect of average education is -0.061,
for HIV-prevalence of, for example, 5, we get -0.061 + 5 * 0.000954 = -0.056,
and for a HIV prevalence of 14.1 such as Malawi, the effect amounts to -0.061 + 14.1 * 0.000954 = -0.048.

The HIV-prevalence on average for these countries is approximately 5.8 %, which gives us a total effect of average education equal to -0.055. This estimate is approximately

the same as the result we got in Model 4 when including only main effects and not interactions (-0.054).

Generally, with such a positive interaction effect, the impact of average education is weaker for countries with high HIV prevalence, such as Zambia and Zimbabwe (see table below) than for countries in the low-prevalence group. The differences are not significant, however. Therefore, we have only certain indications that average education has a somewhat smaller effect on AIDS-related mortality than for mortality in general. Besides, there is an alternative interpretation: There may be certain characteristics of the countries with a high prevalence of HIV that are responsible for the somewhat weaker effect of average education.

The interactions between the HIV prevalence and the mother's own education are not significant either, with one exception: Having an almost completed primary education reduces mortality less in countries with high HIV prevalence than in those with low prevalence. This supports Caldwell's claim that as far as education goes, we have reached a limit. People are well-informed of how the virus is transmitted and what precautions they can take to protect themselves.

Table 6.3. HIV-prevalence in 16 countries in sub-Saharan Africa (adults 15-49 years old).

Country	HIV-prevalence in %
Group 1: Low prevalence	
Madagascar	0.5 (0.2 - 1.2)
Senegal	0.9 (0.4 - 1.5)
Niger	1.1 (0.5 - 1.9)
Mali	1.7 (1.3 - 2.1)
Benin	1.8 (1.2 - 2.5)
Burkina Faso	2.0 (1.5 - 2.5)
Ghana	2.3 (1.9 - 2.6)
Group 2: Medium high prevalence	
Rwanda	3.1 (2.9 - 3.2)
Nigeria	3.9 (2.3 - 5.6)
Cameroon	5.4 (4.9 - 5.9)
Kenya	6.1 (5.2 - 7.0)
Tanzania	6.5 (5.8 - 7.2)
Uganda	6.7 (5.7 - 7.6)
Group 3: High prevalence	
Malawi	14.1 (6.9 - 21.4)
Zambia	17.0 (15.9 - 18.1)
Zimbabwe	20.1 (13.3 - 27.6)

Table 6.4. The effect of education on child mortality when including interaction variables for education and HIV-prevalence.

	Model 7	
Age of mother		
15-19 years	0.51***	(0.03)
20-24 years ²	0	-
25-29 years	-0.18***	(0.03)
30-34 years	-0.22***	(0.03)
35 + years	-0.25***	(0.03)
Year	-0.07***	(0.005)
Boy	0.088***	(0.02)
Mother's education		
0-3 years ²	0	-
4-6 years	-0.12*	(0.04)
7-8 years	-0.18*	(0.065)
9-10 years	-0.38***	(0.09)
11+ years	-0.34**	(0.10)
Average education among women (years)	-0.061***	(0.008)
Religion		
Muslim	0.19***	(0.02)
Traditional religion	0.03	(0.05)
Other/No religion	-0.11*	(0.05)
Electricity	-0.16***	(0.04)
Urban	-0.09*	(0.03)
Wealth index (average)	-0.105***	(0.012)
Interaction mother's education and HIV-prevalence		
0-3 years²	0	-
4-6 years	0.015**	(0.0045)
7-8 years	0.0022	(0.0065)
9-10 years	0.013	(0.0089)
11+ years	-0.008	(0.0111)
Average education among women	0.00954	(0.0007)

¹ Constant term is not shown.
² Reference category
* p < 0.01; ** p < 0.001; *** p < 0.0001

7. Summary and conclusions

The main objective of this thesis has been to see whether child mortality in sub-Saharan Africa is affected by the education level of other women in the community, in addition to the effect of the mother's own education.

Child mortality in sub-Saharan Africa is still higher than in any other region in the world, and although progress has been made over the last 30 years, this is a major problem which slows down further development. In the fight against child mortality, the education of girls is one of the most important weapons. Knowledge on nutrition and hygiene, an improved ability to communicate with health workers and a higher inclination to get their children vaccinated are some of the beneficial effects that a mother's education has on her children's health. Furthermore, a woman's education has been observed to reduce her birth rate and increase the interval between births, which benefits both maternal and child health.

As for the other women in the community, their education may have an impact on child mortality as well. Through the communication with other women, uneducated mothers may pick up useful information on how to take care of their children. The theory that explains this exchange of knowledge and information is known as social diffusion theory and implies in brief that individuals tend to imitate the behaviour of other community members in order to get their approval.

With data for 16 countries in sub-Saharan Africa from the Demographic Health Survey, arranged by Øystein Kravdal, I have estimated logit regression models in SAS with child mortality as the dependent variable. The mother's education, her religion, her household's wealth and whether she lives in an urban area were used as explanatory variables. I estimated 4 models by incorporating the variables one by one, in order to see their effects more clearly.

Confirming the results of other studies (e.g. Caldwell 1979), my models show that the effect of a woman's own education had a significant negative impact on child mortality. The higher the level of education, the lower is the mortality of her children. The effect of education is reduced when variables that indicate the mother's social background and her family's wealth are included. Although education has an impact on the income of the household and thus household wealth at the time of interview, it could also be that her household's current wealth may reflect the economic resources in the woman's family of

origin. This may in turn have contributed to determine whether she has received an education or not. As for the woman's place of residence, this variable is negative and significant in Model 3, but its inclusion reduces the effect of individual education very little.

When the variable for other women's education was included, the effect of individual-level education was further reduced (and the benefits of urban residence were wiped out). The total effect of education on child mortality, however, was strengthened by the inclusion of this variable. In Models 5 and 6, I have showed this by including a linear effect of individual education instead of the categorical one. After estimating these models, it is possible to conclude that in addition to the effect of the mother's own education, other women's level of schooling has a significant impact on child mortality in these African countries.

Sub-Saharan Africa is the most severely affected region when it comes to the prevalence of HIV and even though AIDS is seldom reported as a cause of death for children, many children die indirectly from this disease. In Zambia and Zimbabwe, which are the countries with the highest prevalence rates, 1.8 million children have lost their parents to HIV with the obvious deterring effects on their health. In light of these numbers, I wanted to examine the possible impact of education on AIDS-related mortality. To check for such effects, I estimated models where I included interactions between HIV-prevalence in the country and the education variables.

The interaction effect for average education was positive (though not significant) which indicate that in countries with a high prevalence of HIV, the effect of average education on AIDS-related mortality is weaker than for countries with low HIV-prevalence.

The only significant result was that for 0-3 years of education, which showed a positive interaction effect. In other words, the results show a tendency for a high prevalence of HIV to reduce the impact that education have on AIDS-related mortality. This result supports what was initially claimed by Caldwell (2002): in the fight against HIV, as far as education goes, we may have reached a limit.

A limitation of the methods and data set used in this analysis, however, is that we can not be sure that any variation in child mortality is a result of the difference in average education in a community. In an area with high average level of education there may also, for example, be other gender norms and a higher general level of wealth than in areas with a less educated population.

Furthermore, all individual and community variables refer to the situation at the time of interview, while ideally, we should know the mother's and the other women's education at

the time the child was born. Although a woman in sub-Saharan Africa is not very likely to attend school after having given birth, this is a possible weakness in the method.

The findings in this thesis are important since there has been some dispute as to the magnitude of the effect a woman's own education has on her children's mortality. The results in this analysis, however, show that even when including factors such as wealth and place of residence, the effect of education is strengthened when the variable for other women's education level is included. Thus, the education of young women does not only reduce the mortality risk of their own children, but through social diffusion also the mortality of uneducated mothers' children. This should be taken into consideration when evaluating girls' education as a factor in mortality decline and education should probably be given even more attention in development programs.

As for the impact of education on AIDS-mortality, this is obviously a more complex relationship, seeing as the demand for education and information about the disease may have been saturated. It is possible that other methods should be explored in addition to education, in order to change attitudes and norms regarding for example the use of contraceptives.

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